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(54) METHOD FOR MANUFACTURING IC-CHIP MOUNTING SUBSTRATE

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a method for manufacturing an IC-chip mounting substrate capable of miniaturizing a terminal apparatus, while achieving optical communication with superior connection.
SOLUTION: The method for manufacturing an IC-chip mounting substrate for carrying out the steps, after preparing an optical element inserting substrate and a package substrate and bonding them together includes (1) an optical element mounting step for electrically connecting the optical element with a conductor circuit of the package substrate, after the optical element is mounted on the surface of the package substrate exposed from a perforation formed in the optical element inserting substrate; (2) a resin-filled layer forming step for forming a resin-filled layer by filling a resin-composition material into the perforation formed in the optical element inserting substrate; (3) a through-hole forming step for forming a through-hole through the optical element inserting substrate and the package substrate; and (4) a solder resist layer forming step for forming a solder resist layer on the exposed surface of the optical element inserting substrate and on the exposed surface of the package substrate.

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CLAIMS

[Claim(s)]
[Claim 1] (a) both sides or one side Of Substrate a — a conductor — the conductor which forms a circuit — a circuit formation process — (b) — a conductor — the conductor of the substrate a in which the circuit was formed — the adhesives layer formation process which forms an adhesives layer in a part of circuit agenesis section [at least] — And the substrate for optical element insertion produced through the through-hole formation process which forms a through tube to some substrates a in which (c) adhesives layer was formed, (A) — both sides of Substrate A — a conductor — the first conductor which forms a circuit — a circuit formation process and (B) — said conductor, while forming the resin insulating layer between layers which has the Bahia hall on the substrate A in which the circuit was formed said resin insulating-layer top between layers — a conductor — pass the resin insulation regular placing layer process between layers which forms a circuit, and the solder resist layer formation process which forms a solder resist layer in the (C) outermost layer — with the produced package substrate The manufacture approach of the substrate for IC chip mounting characterized by performing the process of following the (1) - (4) at least after **********. (1) After attaching an optical element in the front face of the package substrate exposed from the through tube formed in said substrate for optical element insertion, the conductor of said optical element and said package substrate — the optical element mounting process of connecting a circuit electrically — (2) It is filled up with a resin constituent in the through tube formed in said substrate for optical element insertion. the resin packed bed formation process which forms a resin packed bed, and (3) — the through hole formation process which forms the through hole which penetrates said substrate for optical element insertion and said package substrate — (4) — the solder resist layer formation process which forms a solder resist layer in the exposure of said optical element insertion substrate, and the exposure of said package substrate. [and]
[Claim 2] The manufacture approach of the substrate for IC chip mounting according to claim 1 which connects an optical element and a package substrate electrically by wirebonding in the process of the above (1).
[Claim 3] The resin packed bed formed at the process of the above (3) is the manufacture approach of the substrate for IC chip mounting according to claim 1 or 2 that the transmission of the communication link wavelength light of the perpendicular direction between the top face and inferior surface of tongue is 90% or more.
[Claim 4] The resin packed bed formed at the process of the above (3) is the manufacture approach of the substrate for IC chip mounting according to claim 1 or 2 that the transmission of the communication link wavelength light per die length of 1mm is 90% or more.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the manufacture approach of the substrate for IC chip mounting.
[0002]
[Description of the Prior Art] In recent years, attentions have gathered for the optical fiber focusing on the communication link field. In especially IT (information technology) field, the communication technology which used the optical fiber for maintenance of the high-speed Internet network is needed. In the communication system using the optical fiber which has the descriptions, such as ** low loss, ** high bandwidth, ** narrow diameter and a light weight, no ** guiding, and ** saving resources, and has this description, compared with the communication system using the conventional metallic cable, the number of repeaters can be reduced sharply, construction and maintenance become easy, and an optical fiber can attain economization of communication system, and high-reliability-ization.
[0003] Moreover, since an optical fiber can multiplex the light of the wavelength from which not only the light of one wavelength but many differ to coincidence with one optical fiber, it can realize the transmission line of the large capacity which can respond to a busy application, and can respond to image service etc.
[0004] Then, in network communication, such as such the Internet, using not only for the communication link of a backbone but for the communication link with a backbone and terminal equipments (a personal computer, mobile one, game, etc.) and the communication link of terminal equipments the optical communication used with the optical fiber is proposed.
[0005] Thus, when using optical communication for the communication link with a backbone and a terminal equipment etc., in order for IC which performs information (signal) processing in a terminal equipment to operate with an electrical signal, it is necessary to attach the equipment (henceforth light/electric transducer) which changes the lightwave signal and electrical signal of optical -> electric transducer, electric -> phototransducer, etc. into a terminal equipment. So, in the conventional terminal equipment, for example, optics, such as a package substrate which mounted IC chip, a photo detector which processes a lightwave signal, and a light emitting device, etc. were mounted separately, electric wiring and optical waveguide were connected to these, and a signal transmission and signal processing were performed.
[0006]
[Problem(s) to be Solved by the Invention] In such a conventional terminal equipment, since IC mounting package substrate and the optic were mounted separately, the whole equipment became large and had become the factor which bars the miniaturization of a terminal equipment. Moreover, in the conventional terminal equipment, since the distance of IC mounting package substrate and an optic was separated, electric wiring distance is long and it was easy to generate the signal error by a cross talk noise etc. at the time of a signal transmission.
[0007]
[Means for Solving the Problem] Then, while this invention person etc. attains the optical communication which is excellent in connection dependability The result of having examined wholeheartedly how to manufacture the substrate for IC chip mounting which can be contributed to the miniaturization of a terminal equipment, When manufacturing the substrate for IC chip mounting, it hit on an idea for the substrate for IC chip mounting which the problem mentioned above by mounting various optics does not generate to be manufactured, and the manufacture approach of the substrate for IC chip mounting of this invention which consists of the following configuration was completed.
[0008] Namely, the manufacture approach of the substrate for IC chip mounting of this invention (a) — both sides or one side of Substrate a — a conductor — the conductor which forms a circuit — a circuit formation

process — (b) — a conductor — the conductor of the substrate a in which the circuit was formed — the adhesives layer formation process which forms an adhesives layer in a part of circuit agenesis section [at least] — And the substrate for optical element insertion produced through the through-hole formation process which forms a through tube to some substrates a in which (c) adhesives layer was formed, (A) — both sides of Substrate A — a conductor — the first conductor which forms a circuit — a circuit formation process and (B) above — a conductor, while forming the resin insulating layer between layers which has the Bahia hall on the substrate A in which the circuit was formed the above-mentioned resin insulating-layer top between layers — a conductor — pass the resin insulation regular placing layer process between layers which forms a circuit, and the solder resist layer formation process which forms a solder resist layer in the (C) outermost layer — with the produced package substrate It is characterized by performing the process of following the (1) - (4) at least after **********. (1) After attaching an optical element in the front face of the package substrate exposed from the through tube formed in the above-mentioned substrate for optical element insertion, the conductor of the above-mentioned optical element and the above-mentioned package substrate — the optical element mounting process of connecting a circuit electrically — (2) It is filled up with a resin constituent in the through tube formed in the above-mentioned substrate for optical element insertion. The resin packed bed formation process which forms a resin packed bed, the through hole formation process which forms the through hole which penetrates the substrate for the (3) above-mentioned optical element insertion, and the above-mentioned package substrate, And the solder resist layer formation process which forms a solder resist layer in the exposure of the (4) above-mentioned optical element insertion substrate, and the exposure of the above-mentioned package substrate.

[0009] Moreover, in the process of (1) in the manufacture approach of the substrate for IC chip mounting of this invention, it is desirable to connect an optical element and a package substrate electrically by wirebonding. Moreover, as for the resin packed bed formed at the process of (3) of the manufacture approach of the above-mentioned substrate for IC chip mounting, it is desirable for the permeability of the communication link wavelength light of the perpendicular direction between the top face and inferior surface of tongue to be 90% or more, and it is desirable for the permeability of the communication link wavelength light per die length of 1mm to be also 90% or more.

[0010]

[Embodiment of the Invention] The manufacture approach of the substrate for IC chip mounting of this invention (a) — both sides or one side of Substrate a — a conductor — the conductor which forms a circuit — a circuit formation process — (b) — a conductor — the conductor of the substrate a in which the circuit was formed — the adhesives layer formation process which forms an adhesives layer in a part of circuit agenesis section [at least] — And the substrate for optical element insertion produced through the through-hole formation process which forms a through tube to some substrates a in which (c) adhesives layer was formed, (A) — both sides of Substrate A — a conductor — the first conductor which forms a circuit — a circuit formation process and (B) above — a conductor, while forming the resin insulating layer between layers which has the Bahia hall on the substrate A in which the circuit was formed the above-mentioned resin insulating-layer top between layers — a conductor — pass the resin insulation regular placing layer process between layers which forms a circuit, and the solder resist layer formation process which forms a solder resist layer in the (C) outermost layer — with the produced package substrate It is characterized by performing the process of following the (1) - (4) at least after **********. (1) After attaching an optical element in the front face of the package substrate exposed from the through tube formed in the above-mentioned substrate for optical element insertion, the conductor of the above-mentioned optical element and the above-mentioned package substrate — the optical element mounting process of connecting a circuit electrically — (2) It is filled up with a resin constituent in the through tube formed in the above-mentioned substrate for optical element insertion. The resin packed bed formation process which forms a resin packed bed, the through hole formation process which forms the through hole which penetrates the substrate for the (3) above-mentioned optical element insertion, and the above-mentioned package substrate, And the solder resist layer formation process which forms a solder resist layer in the exposure of the (4) above-mentioned optical element insertion substrate, and the exposure of the above-mentioned package substrate.

[0011] In addition, although the process of above-mentioned (1) - (4) must not be performed in this sequence, the process of the above (2) must be performed after the process of the above (1) and the process of the above (4) must be performed after the process of the above (3), the process of the above (3) may be performed before the process of the above (1), or the process of the above (2). Moreover, as long as the process of the above (4) is after the process of the above (3), it may be performed before the process of the above (1), or the process of the above (2).

[0012] By the manufacture approach of the substrate for IC chip mounting of this invention, while attaining the

optical communication which is excellent in connection dependability, the substrate for IC chip mounting which can be contributed to the miniaturization of a terminal equipment can be manufactured.

[0013] The manufacture approach of the substrate for IC chip mounting of this invention passes both through lamination and a further predetermined process, after producing separately the substrate for optical element insertion, and a package substrate. Then, in this specification, how to produce the substrate for optical element insertion and the approach of producing a package substrate are first explained separately in order of a process, respectively, and the process which sticks both and is used as the substrate for IC chip mounting is explained after that.

[0014] production of the substrate for optical element insertion — first — the process of the above (a), i.e., both sides of Substrate a, and one side — a conductor — the conductor which forms a circuit — a circuit formation process is performed. performing etching processing, after forming a solid conductor layer in both sides or one side of Substrate a by nonelectrolytic plating processing etc. and specifically forming a resist on this conductor layer — Substrate a top — a conductor — a circuit can be formed. moreover, the thing for which plating resist is formed in both sides or one side of Substrate a, and plating processing and exfoliation of plating resist are performed after that — Substrate a top — a conductor — a circuit is formed.

[0015] As the above-mentioned substrate a, the substrate with which reinforcing materials, such as a glass fiber, consist of resin (for example, glass epoxy resin) with which it sank in, FR-4 substrate, FR-5 substrate, etc. are mentioned to an epoxy resin, polyester resin, polyimide resin, bismaleimide-triazine resin (BT resin) phenol resin, and these resin, for example. Moreover, a double-sided copper-clad laminated circuit board, an one side copper-clad laminated circuit board, a RCC substrate, etc. may be used as a substrate with which the solid conductor layer was formed. in addition, a conformal substrate and the substrate formed with the additive process — a conductor — you may use as a substrate with which the circuit was formed.

[0016] next, the above-mentioned (b) process, i.e., a conductor, — the conductor of the substrate a in which the circuit was formed — the adhesives layer formation process which forms an adhesives layer in a part of circuit agenesis section [at least] is performed. the near conductor stuck with the package substrate of Substrate a at this process — an adhesives layer is formed in all or a part of circuit agenesis sections. What is necessary is just to apply the above-mentioned adhesives layer so that sufficient adhesive property with a package substrate may be acquired. Therefore, it is ** [it may form an adhesives layer in the part in which a through tube is formed at the process of (c) mentioned later].

[0017] As the above-mentioned adhesives, thermosetting resin, thermoplastics, a photopolymer, the resin with which a part of heat-curing radical was sensitization-ized, the thing which consists of these complex can be used, for example. As an example, an epoxy resin, phenol resin, polyimide resin, BT resin, etc. are mentioned, for example. Moreover, the adhesives fabricated in the shape of a sheet may be used beforehand, and prepreg may be used.

[0018] Next, the through-hole formation process which forms a through tube in some substrates a in which it formed, the process, i.e., the adhesives layer, of the above (c), is performed. In the through tube formed here, an optical element will be arranged in a back process. For example, router processing etc. can perform formation of the above-mentioned through tube. Moreover, although especially the formation location of the above-mentioned through tube is not limited, it is usually formed in the center of a substrate.

[0019] moreover, the above-mentioned through-hole formation process — after being and forming a through tube, in order to remove the weld flash which exists in a through tube wall surface, drug solution processing, polish processing, etc. may be performed. The above-mentioned drug solution processing can be performed using the oxidizer which consists of water solutions, such as a chromic acid and a permanganate. Such (a) The substrate for optical element insertion is producible by passing through the process of - (c).

[0020] Next, the production approach of a package substrate is explained. production of a package substrate — first — the process of the above (A), i.e., both sides of Substrate A, — a conductor — the first conductor which forms a circuit — a circuit formation process is performed. This process can be performed by the same approach as the process of (a) of production of the substrate for optical element insertion mentioned above, for example. In addition, as a substrate A, the same thing as the substrate a mentioned above can be used, for example.

[0021] moreover, the conductor whose above-mentioned substrate A was pinched if needed — the through hole which connects between circuits may be formed. The above-mentioned through hole is formed by performing nonelectrolytic plating processing etc. to the wall surface of this through tube, after forming a through tube in the above-mentioned substrate A by drilling, the lasing, etc. Moreover, when a through hole is formed, it is desirable to be filled up with a resin filler in this through hole. In addition, restoration of a resin filler can lay on a substrate the mask with which opening was formed in the part equivalent to a through hole, and can be performed using a squeegee.

[0022] moreover, a conductor — roughening formation processing may be performed to a circuit front face (the land front face of a through hole is included). a conductor — it is because adhesion with the resin insulating layer between layers which carries out laminating formation at a back process by making a circuit front face into a roughening side improves. as the above-mentioned roughening formation processing — melanism (oxidization) — the etching processing using the etching reagent containing - reduction processing, the second copper complex, and an organic-acid salt etc., processing by the Cu-nickel-P needlelike alloy plating, etc. are mentioned. In addition, before this roughening formation processing is filled up with a resin filler in a through hole, it may be performed, and it may form a roughening side also in the wall surface of a through hole. It is because the adhesion of a through hole and a resin filler improves.

[0023] As a resin filler with which it is filled up in the above-mentioned through hole, the resin constituent containing an epoxy resin, a curing agent, and an inorganic particle etc. is mentioned, for example. Although not limited especially as the above-mentioned epoxy resin, a kind is [choose / from the group which consists of a bisphenol mold epoxy resin and a novolak mold epoxy resin] desirable in it being few. It is because a novolak mold epoxy resin is excellent in thermal resistance or chemical resistance with high intensity, the viscosity can be prepared even if a diluent solvent is not used for a bisphenol mold epoxy resin by choosing the resin of A mold or a female mold, it is not disassembled even if it is among strong base nature solutions, such as nonelectrolytic plating liquid, and it is hard to carry out a pyrolysis.

[0024] As the above-mentioned bisphenol mold epoxy resin, the bisphenol A mold epoxy resin and a bisphenol female mold epoxy resin are desirable, and the point which is hypoviscosity and can be used with a non-solvent to a bisphenol female mold epoxy resin is more desirable. Moreover, as the above-mentioned novolak mold epoxy resin, a kind is [choose / from a phenol novolak mold epoxy resin and a cresol novolak mold epoxy resin] desirable in it being few.

[0025] Moreover, a bisphenol mold epoxy resin and a cresol novolak mold epoxy resin may be mixed and used. In this case, as for the mixed ratio of a bisphenol mold epoxy resin and a cresol novolak mold epoxy resin, it is desirable that it is 1 / 1 - 1/100 in a weight ratio.

[0026] It is not limited especially as a curing agent contained in the above-mentioned resin filler, a well-known curing agent can be used conventionally, for example, an imidazole system curing agent, an acid-anhydride curing agent, an amine system curing agent, etc. are mentioned. In these, an imidazole system curing agent is desirable and liquefied 1-benzyl-2-methylimidazole, and 1-cyanoethyl-2-ethyl-4-methylimidazole and a 4-methyl-2-ethyl imidazole are desirable in 25 degrees C especially.

[0027] Moreover, as an inorganic particle contained in the above-mentioned resin filler, what consists of titanium compounds, such as silicon compounds, such as magnesium compounds, such as potassium compounds, such as lime compounds, such as aluminium compounds, such as an alumina and an aluminum hydroxide, a calcium carbonate, and a calcium hydroxide, and potassium carbonate, a magnesia, a dolomite, basic magnesium carbonate, and talc, a silica, and a zeolite, and a titania, etc. is mentioned, for example. These may be used independently and may be used together two or more sorts. Moreover, coating of the above-mentioned inorganic particle may be carried out by the silane coupling agent etc. It is because the adhesion of an inorganic particle and an epoxy resin improves.

[0028] Moreover, the content ratio in the resin constituent of the above-mentioned inorganic particle has 10 - 80 desirable % of the weight, and its 20 - 70 % of the weight is more desirable. It is because adjustment of a coefficient of thermal expansion can be aimed at between a substrate or the resin insulating layer between layers if it is this range.

[0029] Moreover, especially the configuration of the above-mentioned inorganic particle is not limited, but the shape of a globular shape, an ellipse globular shape, the letter of crushing, and a polyhedron etc. is mentioned. In these, the shape of the shape of a ball or an ellipse ball is desirable. It is because generating of the crack resulting from the configuration of a particle etc. can be controlled. The mean particle diameter of the above-mentioned inorganic particle has desirable 0.01-5.0 micrometers.

[0030] Moreover, in the above-mentioned resin constituent, other thermosetting resin, thermoplastics, etc. may be contained in addition to the above-mentioned epoxy resin etc. As the above-mentioned thermosetting resin, polyimide resin, phenol resin, etc. are mentioned, for example. As the above-mentioned thermoplastics For example, a polytetrafluoroethylene (PTFE) and ethylene tetrafluoride 6 fluoride propylene copolymer (FEP), Fluororesins, such as an ethylene tetrafluoride perphloro alkoxy copolymer (PFA), Polyethylene terephthalate (PET), polysulfone (PSF), A polyphenylene sulfide (PPS), thermoplastic mold polyphenylene ether (PPE), Polyether sulfone (PES), polyether imide (PEI), polyphenylene sulfone (PPES), polyethylenenaphthalate (PEN), a polyether ether ketone (PEEK), polyolefine system resin, etc. are mentioned. These may be used independently and may use two or more sorts together. In addition, it may replace with the above-mentioned epoxy resin, and these resin may be used.

[0031] next, the process of the above (B), i.e., the above, — a conductor — while forming the resin insulating layer between layers which has the Bahia hall on the substrate A in which the circuit was formed — the above-mentioned resin insulating-layer top between layers — a conductor — the resin insulation regular placing layer process between layers which forms a circuit is performed. Specifically, it can carry out by passing through the process of following (i) - (vi). namely, (i) — first — a conductor — the resin layer which forms the non-hardened resin layer which consists of thermosetting resin or resin complex on the substrate A in which the circuit was formed, or consists of thermoplastics is formed. The resin layer which is not hardened [above-mentioned] may apply non-hardened resin by the roll coater, a curtain coating machine, etc., may fabricate it, and may carry out thermocompression bonding of the resin film non-hardened (semi-hardening), and may form it. Furthermore, the resin film with which metal layers, such as copper foil, were formed in one side of a non-hardened resin film may be stuck. Moreover, as for the resin layer which consists of thermoplastics, it is desirable to form by carrying out thermocompression bonding of the resin Plastic solid fabricated in the shape of a film.

[0032] In applying the resin which is not hardened [above-mentioned], it performs heat-treatment, after applying resin. Heat curing of the non-hardened resin can be carried out by performing the above-mentioned heat-treatment. In addition, the above-mentioned heat curing may be performed after forming opening for the Bahia halls mentioned later.

[0033] As an example of the thermosetting resin used in formation of such a resin layer, an epoxy resin, phenol resin, polyimide resin, polyester resin, a bismaleimide resin, polyolefine system resin, polyphenylene ether resin, etc. are mentioned, for example.

[0034] As the above-mentioned epoxy resin, a cresol novolak mold epoxy resin, the bisphenol A mold epoxy resin, a bisphenol female mold epoxy resin, a phenol novolak mold epoxy resin, an alkylphenol novolak mold epoxy resin, a biphenol female mold epoxy resin, a naphthalene mold epoxy resin, a dicyclopentadiene mold epoxy resin, the epoxidation object of the condensate of phenols and the aromatic aldehyde which has a phenolic hydroxyl group, triglycidyl isocyanurate, cycloaliphatic epoxy resin, etc. are mentioned, for example. These may be used independently and may be used together two or more sorts. Thereby, it excels in thermal resistance etc.

[0035] As the above-mentioned polyolefine system resin, the copolymer of polyethylene, polystyrene, polypropylene, a polyisobutylene, polybutadiene, polyisoprene, cycloolefin system resin, and these resin etc. is mentioned, for example.

[0036] Moreover, as the above-mentioned thermoplastics, phenoxy resin, polyether sulfone, polysulfone, etc. are mentioned, for example. Moreover, as complex (resin complex) of thermosetting resin and thermoplastics, especially if thermosetting resin and thermoplastics are included, it will not be limited, but as the example, the resin constituent for roughening side formation etc. is mentioned, for example.

[0037] That by which the matter of fusibility was distributed to the roughening liquid which consists of at least one sort chosen from an acid, alkali, and an oxidizer into the heat-resistant-resin matrix which is not hardened [poorly soluble] to the roughening liquid which consists of at least one sort chosen from an acid, alkali, and an oxidizer as the above-mentioned resin constituent for roughening side formation, for example is mentioned. In addition, when the same time amount immersion is carried out, the word of the above "poor solubility" and "fusibility" says relatively what has an early dissolution rate as "fusibility" to the same roughening liquid for convenience, and calls "poor solubility" relatively what has a late dissolution rate to it for convenience.

[0038] In case the above-mentioned roughening liquid is used for the resin insulating layer between layers and a roughening side is formed as the above-mentioned heat-resistant-resin matrix, what can hold the configuration of a roughening side is desirable, for example, thermosetting resin, thermoplastics, these complex, etc. are mentioned. Moreover, you may be a photopolymer. In the process which forms opening for the Bahia halls mentioned later, it is because opening can be formed by the exposure development.

[0039] As the above-mentioned thermosetting resin, an epoxy resin, phenol resin, polyimide resin, polyolefin resin, a fluororesin, etc. are mentioned, for example. Moreover, the resin which made the heat-curing radical acrylic(meta)—ization-react to these thermosetting resin using the resin which gave photosensitivity, i.e., a methacrylic acid, an acrylic acid, etc., may be used. The acrylate (meta) of an epoxy resin is desirable and, specifically, the epoxy resin which has two or more epoxy groups in 1 molecule is more more desirable still.

[0040] As the above-mentioned thermoplastics, phenoxy resin, polyether sulfone, polysulfone, polyphenylene sulfone, polyphenylene sulfide, a polyphenyl ether, polyether imide, etc. are mentioned, for example. These may be used independently and may be used together two or more sorts.

[0041] As matter of the above-mentioned fusibility, an inorganic particle, a resin particle, metal particles, a rubber particle, liquid phase resin, liquid phase rubber, etc. are mentioned, for example. These may be used independently and may be used together two or more sorts.

[0042] As the above-mentioned inorganic particle, what consists of titanium compounds [, such as a silicon compound; titania,], such as magnesium compound; silicas, such as potassium compound; magnesias [, such as

lime compound; potassium carbonate,], such as aluminium compound; calcium carbonates, such as an alumina and an aluminum hydroxide, and a calcium hydroxide, a dolomite, basic magnesium carbonate, and talc, and a zeolite, etc. is mentioned, for example. These may be used independently and may be used together two or more sorts. Dissolution removal of the above-mentioned alumina particle can be carried out by fluoric acid, and dissolution removal of the calcium carbonate can be carried out with a hydrochloric acid. Moreover, dissolution removal of a sodium content silica or the dolomite can be carried out in an alkali water solution.

[0043] As the above-mentioned resin particle, what consists of thermosetting resin, thermoplastics, etc. is mentioned, for example. When immersed in the roughening liquid which consists of at least one sort chosen from an acid, alkali, and an oxidizer It will not be limited especially if a dissolution rate is earlier than the above-mentioned heat-resistant-resin matrix. Specifically For example, what consists of amino resin (melamine resin, a urea-resin, guanamine resin, etc.), an epoxy resin, phenol resin, phenoxy resin, polyimide resin, polyphenylene resin, polyolefin resin, a fluororesin, bismaleimide-triazine resin, etc. is mentioned. These may be used independently and may be used together two or more sorts. In addition, the above-mentioned resin particle needs to carry out hardening processing beforehand. It is because the above-mentioned resin particle dissolves in the solvent in which a resin matrix is dissolved, so homogeneity will be mixed and dissolution removal only of the resin particle can be alternatively carried out neither with an acid nor an oxidizer, unless it makes it harden.

[0044] As the above-mentioned metal particles, what consists of gold, silver, copper, tin, zinc, stainless steel, aluminum, nickel, iron, lead, etc. is mentioned, for example. These may be used independently and may be used together two or more sorts. Moreover, the surface may be covered with resin etc. in order that the above-mentioned metal particles may secure insulation.

[0045] (ii) Next, in forming the resin insulating layer between layers using thermosetting resin and resin complex as the ingredient, while performing hardening processing to a non-hardened resin layer, opening for the Bahia halls is formed and it considers as the resin insulating layer between layers. As for the above-mentioned opening for the Bahia halls, forming by the lasing is desirable. The above-mentioned lasing may be performed before the above-mentioned hardening processing, and may be performed after hardening processing. Moreover, when the resin insulating layer between layers which consists of a photopolymer is formed, opening for the Bahia halls may be prepared by performing exposure and a development. In addition, exposure and a development are performed before the above-mentioned hardening processing in this case.

[0046] Moreover, when forming the resin insulating layer between layers using thermoplastics as the ingredient, opening for the Bahia halls can be formed in the resin layer which consists of thermoplastics by the lasing, and it can consider as the resin insulating layer between layers.

[0047] At this time, carbon dioxide gas laser, excimer laser, UV laser, an YAG laser, etc. are mentioned as laser to be used, for example. These may be properly used in consideration of the configuration of opening for the Bahia halls to form etc.

[0048] When forming the above-mentioned opening for the Bahia halls, much openings for the Bahia halls can be formed at once by irradiating the laser beam by the excimer laser of a hologram method through a mask. Moreover, when opening for the Bahia halls is formed using the carbon dioxide gas laser of a short pulse, there is little resin remainder in opening and the damage to the resin of an opening periphery is small.

[0049] Moreover, when irradiating a laser beam through an optical-system lens and a mask, much openings for the Bahia halls can be formed at once. By minding an optical-system lens and a mask, it is the same reinforcement and is because whenever [illuminating-angle] can irradiate the same laser beam at coincidence at two or more parts.

[0050] (iii) Next, a roughening side is formed in the front face of the resin insulating layer between layers including the wall of opening for the Bahia halls using an acid or an oxidizer if needed. In addition, this roughening side is formed in order to raise the adhesion of the resin insulating layer between layers, and the thin film conductor layer formed on it, and when there is adhesion sufficient between the resin insulating layer between layers and a thin film conductor layer, it is not necessary to form it.

[0051] As the above-mentioned acid, a sulfuric acid, a nitric acid, a hydrochloric acid, a phosphoric acid, formic acid, etc. are mentioned, and permanganates, such as a chromic acid, chromate acid mixture, and sodium permanganate, etc. are mentioned as the above-mentioned oxidizer. Moreover, after forming a roughening side, it is desirable to neutralize the front face of the resin insulating layer between layers using water solutions, neutralization liquid, etc., such as alkali. It is because it can avoid having effect of an acid or an oxidizer on degree process. Moreover, formation of the above-mentioned roughening side may be performed using plasma treatment etc.

[0052] Moreover, the maximum roughness Rmax of the above-mentioned roughening side has desirable 0.1-20 micrometers. if Rmax exceeds 20 micrometers — the roughening side itself — damage and exfoliation — winning popularity — easy — Rmax — less than 0.1 micrometers — a conductor — it is because adhesion with a circuit

cannot be acquired enough. especially — a semiadditive process — a conductor — when forming a circuit, the above-mentioned maximum roughness Rmax has desirable 0.1-5 micrometers. While adhesion with a thin film conductor layer is fully securable, it is because removal of a thin film conductor layer is easy.

[0053] (iv) Next, a thin film conductor layer is formed in the front face of the resin insulating layer between layers which prepared opening for the Bahia halls. The above-mentioned thin film conductor layer can be formed using approaches, such as nonelectrolytic plating, sputtering, and vacuum evaporationo. In addition, when a roughening side is not formed in the front face of the resin insulating layer between layers, as for the above-mentioned thin film conductor layer, forming by sputtering is desirable. In addition, in forming a thin film conductor layer with nonelectrolytic plating, it gives the catalyst beforehand to the galvanized front face. As the above-mentioned catalyst, a palladium chloride etc. is mentioned, for example.

[0054] Although especially the thickness of the above-mentioned thin film conductor layer is not limited, when this thin film conductor layer is formed with nonelectrolytic plating, 0.6-1.2 micrometers is desirable, and when it forms by sputtering, 0.1-1.0 micrometers is desirable. Moreover, as the quality of the material of the above-mentioned thin film conductor layer, Cu, nickel, P, Pd, Co, W, etc. are mentioned, for example. In these, Cu and nickel are desirable.

[0055] (v) Next, a dry film is used for the part on the above-mentioned thin film conductor layer, plating resist is formed, after that, electrolysis plating is performed by making the above-mentioned thin film conductor layer into a plating bar, and an electrolysis plating layer is formed in the plating-resist agenesis section.

[0056] Moreover, opening for the Bahia halls is filled up with this process with electrolysis plating, and it is good also considering the structure of the Bahia hall as field beer structure, and the Bahia hall which has a hollow is once formed in that top face, this hollow is filled up with a conductive paste after that, and it is good also as field beer structure. Moreover, after forming in a top face the Bahia hall which has a hollow, the hollow is filled up with a resin filler etc., a lid plating layer is further formed on it, and it is good also as a Bahia hall where a top face is flat. The Bahia hall can be formed in right above [of the Bahia hall] by making structure of the Bahia hall into field beer structure.

[0057] (vi) — the conductor which exfoliated plating resist, removed further the thin film conductor layer which existed under plating resist by etching, and became independent — it considers as a circuit. As an etching reagent, persulfate water solutions, such as a sulfuric-acid-hydrogen-peroxide-solution solution and ammonium persulfate, a ferric chloride, a cupric chloride, a hydrochloric acid, etc. are mentioned, for example. Moreover, the mixed solution containing the second copper complex mentioned above as an etching reagent and an organic acid may be used.

[0058] moreover, the thing for which it replaces with the approach of performing removal with plating resist and a thin film conductor layer, and the following approaches are used after forming plating resist on the above-mentioned thin film conductor layer and forming an electrolysis plating layer in the plating-resist agenesis section — a conductor — a circuit may be formed. namely, the conductor which used the dry film for the part on this electrolysis plating layer, formed etching resist, removed an etching-resist agenesis subordinate's electrolysis plating layer and thin film conductor layer by etching after that, and became independent by exfoliating etching resist further after forming an electrolysis plating layer the whole surface on the above-mentioned thin film conductor layer — a circuit may be formed.

[0059] while forming the resin insulating layer between layers which has the Bahia hall by using such an approach — the resin insulating-layer top between layers — a conductor — the resin insulation regular placing layer process between layers which forms a circuit can be performed. in addition, the thing for which this resin insulation regular placing layer process between layers is repeated two or more times in the manufacture approach of this invention depending on IC chip mounting substrate to manufacture although this resin insulation regular placing layer process between layers was performed only once — the resin insulating layer between layers, and a conductor — it is good also as a gestalt by which every laminating formation of the circuit was carried out more than two-layer.

[0060] Next, the process of the above (C), i.e., the solder resist layer formation process which forms a solder resist layer in the outermost layer, is performed. After applying a non-hardened solder resist constituent by the roll coater, curtain coater, etc. or specifically sticking by pressure the solder resist constituent fabricated in the shape of a film, a solder resist layer is formed by performing hardening processing.

[0061] The above-mentioned solder resist layer is [0062] which can be formed using the solder resist constituent containing for example, polyphenylene ether resin, polyolefin resin, a fluororesin, thermoplastic elastomer, an epoxy resin, polyimide resin, etc. moreover, as solder resist constituents other than the above For example, the acrylate (meta) of a novolak mold epoxy resin, an imidazole curing agent, 2 functionality (meta) acrylic ester monomer, the polymer of with a molecular weight of about 500 to 5000 acrylic ester (meta), The fluid of the shape of a paste containing photosensitive monomers, such as thermosetting resin which consists of

a bisphenol mold epoxy resin etc., and a multiple-valued acrylic monomer, a glycol ether system solvent, etc. is mentioned, and, as for the viscosity, it is desirable to be adjusted to 1 - 10 Pa-s at 25 degrees C. Moreover, as for the above-mentioned solder resist constituent, the elastomer and the inorganic filler may be blended. Moreover, a commercial solder resist constituent may be used as a solder resist constituent.

[0063] Moreover, opening for solder bump formation is formed in the above-mentioned solder resist layer by the lasing or the exposure development if needed. Under the present circumstances, the same thing as the laser used in case opening for the Bahia halls mentioned above is formed as laser to be used etc. is mentioned.

[0064] next, the conductor exposed to the base of the above-mentioned opening for solder bump formation — a metal layer is formed on the surface of a circuit if needed. the above-mentioned metal layer — corrosion-resistant metals, such as nickel, palladium, gold, silver, and platinum, — the above — a conductor — it can form by covering a circuit front face. Specifically, it is desirable to form with metals, such as nickel-gold, nickel-silver, nickel-palladium, and nickel-palladium-gold. Moreover, although the above-mentioned solder pad can be formed using approaches, such as plating, vacuum evaporationo, and electrodeposition, in these, the point of excelling in the homogeneity of an enveloping layer to its plating is desirable. Moreover, the mark for alignment used at the process mentioned later in the case of lamination with the substrate for optical element insertion may be formed in the solder resist layer formed at this process. Such (A) A package substrate is producible by passing through the process of - (C).

[0065] next, pass the process of above-mentioned (a) - (c) — the process of the produced substrate for optical element insertion and above-mentioned (A) - (C) passes — after sticking the produced package substrate through the adhesives layer which the substrate for optical element insertion has, the process of above-mentioned (1) - (4) passes — how to use as the substrate for IC chip mounting explains.

[0066] Lamination of the substrate for optical element insertion and a package substrate can be performed using for example, a pin lamination method, a mass lamination method, etc. After performing both alignment, specifically, the substrate for optical element insertion and a package substrate are stuck by carrying out a temperature up to the temperature (usually about 60-200 degrees C) which an adhesives layer softens, and subsequently pressing by the pressure of 1 - 10MPa extent.

[0067] first, the conductor of the above-mentioned optical element after attaching an optical element in the process of the above (1), i.e., the front face of the package substrate exposed from the through tube formed in the above-mentioned substrate for optical element insertion, and the above-mentioned package substrate — the optical element mounting process of connecting a circuit electrically is performed.

[0068] As an optical element mounted at this process, light emitting devices, such as photo detectors, such as PD (photodiode) and APD (avalanche photodiode), LD (semiconductor laser), DFB-LD (distribution feedback mold-semiconductor laser), and LED (light emitting diode), etc. are mentioned, for example.

[0069] As an ingredient of the above-mentioned photo detector, Si, germanium, InGaAs, etc. are mentioned, for example. In these, a point to InGaAs which is excellent in light-receiving sensibility is desirable. Moreover, as an ingredient of the above-mentioned light emitting device, a gallium, arsenic and the compound (GaAsP) of Lynn, a gallium, aluminum and the compound (GaAlAs) of arsenic, a gallium and the compound (GaAs) of arsenic, an indium, a gallium and the compound (InGaAs) of arsenic, an indium, a gallium, arsenic, the compound (InGaAsP) of Lynn, etc. are mentioned, for example. That what is necessary is just to use these properly in consideration of communication link wavelength, when communication link wavelength is 0.85-micrometer band, GaAlAs can be used, and in the case of 1.3-micrometer band or 1.55-micrometer band, communication link wavelength can use InGaAs and InGaAsP.

[0070] Installation of the above-mentioned optical element can be performed by for example, the eutectic joining-together method, the solder joining-together method, a resin bond method, etc. Moreover, an optical element may be attached using a silver paste metallurgy paste. By the describing [above] resin bond method, thermosetting resin, such as epoxy system resin and polyimide system resin, is used as base resin, the paste which contains a curing agent, a filler, a solvent, etc. in addition to these resinous principles is applied on a package substrate, and subsequently to a paste top, after laying an optical element, an optical element is attached by carrying out heat hardening of this paste. In addition, spreading of the above-mentioned paste can be performed with for example, the dispensing method, the **********ing method, screen printing, etc. In using a silver paste, a silver paste is applied on a package substrate, and after laying an optical element, subsequently to a paste top, it attaches an optical element by calcinating this silver paste.

[0071] the conductor of the above-mentioned optical element and the above-mentioned package substrate — as an approach of connecting a circuit electrically, it is desirable to use wirebonding. It is because it is economically advantageous while this has the large degree of freedom of the design at the time of attaching an optical element. As the above-mentioned wirebonding, a well-known approach, i.e., the nail-head-bonding method and the wedge bonding method, can be used conventionally. In addition, connection between an optical element

and a package substrate may be made by tape automated bonding, flip chip bonding, etc.
[0072] Next, it is filled up with a resin constituent in the process of the above (2), i.e., the through tube formed in the above-mentioned substrate for optical element insertion, and the resin packed bed formation process which forms a resin packed bed is performed. What uses as a resinous principle thermosetting resin, thermoplastics, a photopolymer, the resin with which some thermosetting resin was photosensitivity-ized, these complex, etc. as the above-mentioned resin constituent is mentioned. As an example of the above-mentioned resinous principle, an epoxy resin, phenol resin, polyimide resin, olefine resin, BT resin, etc. are mentioned, for example. Moreover, particles, such as for example, a resin particle, an inorganic particle, and metal particles, may be contained in the above-mentioned resin constituent in addition to the above-mentioned resinous principle. By including these particles, adjustment of a coefficient of thermal expansion can be aimed at between a resin packed bed, a substrate and a solder resist layer, the resin insulating layer between layers, etc., and fire retardancy can also be given depending on the class of particle.
[0073] As the above-mentioned resin particle, the resin complex of thermosetting resin, thermoplastics, a photopolymer, the resin with which some thermosetting resin was photosensitivity-ized, thermosetting resin, and thermoplastics, the complex of a photopolymer and thermoplastics, etc. are mentioned, for example.
[0074] Specifically For example, an epoxy resin, phenol resin, polyimide resin, Thermosetting resin, such as a bismaleimide resin, polyphenylene resin, polyolefin resin, and a fluororesin; The heat-curing radical of these thermosetting resin A methacrylic acid, an acrylic acid, etc. are made to react to (for example, the epoxy group in an epoxy resin). Resin which gave the acrylic radical; Phenoxy resin, polyether sulfone (PES), Thermoplastics, such as polysulfone (PSF), a polyphenylene sulfone (PPS), polyphenylene sulfide (PPES), a polyphenyl ether (PPE), and polyether imide (PI); photopolymers, such as acrylic resin, etc. are mentioned. Moreover, the resin complex of the resin complex of the above-mentioned thermosetting resin and the above-mentioned thermoplastics, the resin which gave the above-mentioned acrylic radical, the above-mentioned photopolymer, and the above-mentioned thermoplastics can also be used. Moreover, the resin particle which consists of rubber can also be used as the above-mentioned resin particle.
[0075] Moreover, as the above-mentioned inorganic particle, titanium compounds, such as silicon compounds, such as magnesium compounds, such as potassium compounds, such as lime compounds, such as aluminium compounds, such as an alumina and an aluminum hydroxide, a calcium carbonate, and a calcium hydroxide, and potassium carbonate, a magnesia, a dolomite, and basic magnesium carbonate, a silica, and a zeolite, and a titania, etc. are mentioned, for example. Moreover, what consists of Lynn or phosphorus compounds can also be used as the above-mentioned inorganic particle.
[0076] As the above-mentioned metal particles, Au, Ag, Cu, Pd, nickel, Pt, Fe, Zn, Pb, aluminum, Mg, calcium, etc. are mentioned, for example. These resin particles, an inorganic particle, and metal particles may be used independently, respectively, and may be used together two or more sorts.
[0077] Moreover, especially the configuration of the above-mentioned particle is not limited, for example, the shape of a globular shape, an ellipse globular shape, the letter of crushing, and a polyhedron etc. is mentioned. Moreover, as for the particle size (the die length of the longest part of a particle) of the above-mentioned particle, it is desirable that it is shorter than the wavelength of communication link light. It is because transmission of a lightwave signal may be checked when particle size is longer than the wavelength of communication link light.
[0078] It is not limited especially as an approach filled up with the above-mentioned resin constituent, for example, approaches, such as printing and potting, can be used. Moreover, it may be filled up with what was made into the shape of a tablet using a plunger. Moreover, after being filled up with a resin packed bed, hardening processing etc. is performed if needed.
[0079] Moreover, as for the resin packed bed formed at this process, it is desirable for the permeability of the communication link wavelength light of the perpendicular direction between that top face and inferior surface of tongue to be 90% or more. It is because un-arranging may occur in the communication link of the lightwave signal with which transmission of communication link light was checked and the above-mentioned permeability minded the optical element at less than 90%. In addition, in this specification, the permeability (%) of the communication link wavelength light of the perpendicular direction between the top face of a resin packed bed and an inferior surface of tongue is a value computed from the following formula (1), when the intensity of light which passed I1 and the above-mentioned resin packed bed, and came out of the strength of the incident light of the perpendicular direction to the above-mentioned resin packed bed is set to I2.
[0080]
Permeability (%) =(I2/I1) x100 ... (1)
[0081] Moreover, as for a resin packed bed, it is desirable for the permeability of communication link wavelength light to be also 90% or more per die length of 1mm. When the thickness of the resin packed bed formed at this

process is taken into consideration, the resin packed bed which has the permeability of the above-mentioned range is because it fully excels in the transmission nature of communication link light.

[0082] In addition, in this specification, the permeability (%) of the communication link wavelength light per die length of 1mm is a value computed by the following formula (2), when the intensity of light which came out when the light of I3 carried out incidence to the above-mentioned resin packed bed in strength, and passing this resin packed bed 1mm and having come out is I4.

[0083]

Permeability (%) =(I4/I3) x100 ... (2)

[0084] Moreover, in case a resin constituent is filled up with this process, multiple times may be divided and filled up with a different resin constituent, and the resin layer which consists of two or more layers may be formed in a through tube. It is filling up the field to the height of the light-receiving side of a photo detector, or the luminescence side of a light emitting device with the resin constituent excellent in the property protecting wirebonding and its connection area, and the resin constituent excellent in especially thermal resistance, and specifically forming a resin packed bed especially in a field higher than the above-mentioned light-receiving side and a luminescence side using the resin constituent which is excellent in the transmission nature of communication link light etc.

[0085] Furthermore, it is desirable to perform polish processing to the exposure of the resin constituent exposed from the through tube at this process, and to make that exposure flat. By making an exposure flat, it is because a possibility that transmission of communication link light may be checked decreases more. Polish by buffing, a sandpaper, etc., mirror polishing, clean polish, wrapping, etc. can perform the above-mentioned polish processing. Moreover, chemical polishing using an acid, an oxidizer, a drug solution, etc. may be performed. Moreover, two or more sorts of polish processings may be performed combining these approaches.

[0086] Next, the process of the above (3), i.e., the through hole formation process which forms the through hole which penetrates the above-mentioned substrate for optical element insertion and the above-mentioned package substrate, is performed. Specifically, the through tube for through holes which penetrates the above-mentioned substrate for optical element insertion and the above-mentioned package substrate is formed first. What is necessary is just to form this through tube for through holes by drilling, the lasing, etc. As laser used for the above-mentioned lasing, in case a package substrate is produced, the same thing as the laser used at the process which forms opening for the Bahia halls etc. can be used, for example.

[0087] Next, a thin film conductor layer is formed in the exposure of the substrate for optical element insertion containing the wall surface of the through tube for through holes, and the exposure of a package substrate. The above-mentioned thin film conductor layer can be formed by approaches, such as nonelectrolytic plating and sputtering.

[0088] As the quality of the material of the above-mentioned thin film conductor layer, copper, nickel, tin, zinc, cobalt, a thallium, lead, etc. are mentioned, for example. In these, what consists of the copper from a point, copper, and nickel which are excellent in an electrical property, economical efficiency, etc. is desirable. Moreover, as thickness of the above-mentioned thin film conductor layer, when forming a thin film conductor layer with nonelectrolytic plating, 0.3-2.0 micrometers is desirable and 0.6-1.2 micrometers is more desirable. Moreover, when forming by sputtering, 0.1-1.0 micrometers is desirable.

[0089] Next, plating resist is formed on the substrate with which the thin film conductor layer was formed in the front face. After the above-mentioned plating resist sticks for example, a photosensitive dry film, it can carry out adhesion arrangement of the photo mask which consists of a glass substrate with which the plating resist pattern was drawn, and can form it by performing an exposure development.

[0090] Furthermore, electroplating is performed by making a thin film conductor layer into a plating bar, and an electroplating layer is formed in the above-mentioned plating-resist agenesis section. As the above-mentioned electroplating, copper plating is desirable. Moreover, the thickness of the above-mentioned electroplating layer and 5-20 micrometers are desirable.

[0091] Then, a through hole (the land part is included) can be formed by removing the thin film conductor layer under the above-mentioned plating resist and this plating resist. What is necessary is just to perform removal of the above-mentioned thin film conductor layer using etching reagents, such as mixed liquor of a sulfuric acid and a hydrogen peroxide, sodium persulfate, ammonium persulfate, a ferric chloride, and a cupric chloride, that what is necessary is just to perform removal of the above-mentioned plating resist for example, using an alkali water solution etc. moreover, the above — a conductor — after forming a circuit, the catalyst on the resin insulating layer between layers may be removed using an acid or an oxidizer if needed. It is because the fall of an electrical property can be prevented. Moreover, after replacing with the approach of forming an electroplating layer after forming this plating resist and forming an electroplating layer the whole surface on a thin film conductor layer, etching resist and a solder plating layer may be formed on an electrolysis plating layer, and a through hole may

be further formed using the approach of performing etching processing.
[0092] Moreover, after forming a through hole, it is desirable to be filled up with a resin filler in this through hole. As the above-mentioned resin filler, the same thing as the resin filler used for the restoration in a through hole etc. can be used, for example in production of a package substrate.
[0093] Moreover, when it is filled up with a resin filler and a resin filler layer is formed in a through hole, a wrap iid plating layer may be formed for the surface section of a resin filler layer by performing nonelectrolytic plating etc. if needed. It is because it becomes possible to form a solder pad by forming a lid plating layer not only the land top of a through hole but on a lid plating layer, so the degree of freedom of a design improves more.
[0094] Moreover, as mentioned above, after this through hole formation process performs the above (1) and the process of (2), it is not necessary to perform it, before it performs, the process, i.e., the optical element mounting process, of the above (1), it may be performed, and before performing the process of the above (2), i.e., the above-mentioned resin packed bed formation process, it may be performed.
[0095] Next, the process of the above (4), i.e., the solder resist layer formation process which forms a solder resist layer in the exposure of the above-mentioned substrate for optical element insertion and the exposure of the above-mentioned package substrate, is performed. At this process, after applying a non-hardened solder resist constituent by the roll coater, curtain coater, etc. or specifically sticking by pressure the solder resist constituent fabricated in the shape of a film, a solder resist layer is formed by performing hardening processing. The same thing as the solder resist constituent used as the above-mentioned solder resist constituent, for example when producing a package substrate etc. can be used. In addition, in this solder resist layer formation process, it is not necessary to form a solder resist layer on the resin packed bed formed at the process of the above (2).
[0096] Moreover, opening for solder bump formation is formed in the above-mentioned solder resist layer by the lasing or the exposure development if needed. Under the present circumstances, the same thing as the laser used in case opening for the Bahia halls mentioned above is formed as laser to be used etc. is mentioned.
[0097] Moreover, as long as it carries out after performing the process which above (3) Reaches, before this solder resist layer formation process performs, the process, i.e., the optical element mounting process, of the above (1), it may be performed, and as mentioned above, before performing the process of the above (2), i.e., the above-mentioned resin packed bed formation process, it may be performed. In addition, when performing this solder resist layer formation process before performing the above (1) and the process of (2), the wall surface of the through tube formed in the exposure of the above-mentioned substrate for optical element insertion since an optical element was mounted shall not be included, and the front face of the package substrate exposed to the base of the through tube formed since an optical element was mounted shall not be included in the exposure of the above-mentioned package substrate.
[0098] next, the conductor exposed to the base of the above-mentioned opening for solder bump formation — a metal layer is formed on the surface of a circuit if needed. the above-mentioned metal layer -- corrosion-resistant metals, such as nickel, palladium, gold, silver, and platinum, — the above — a conductor — it can form by covering a circuit front face. Specifically, it is desirable to form with metals, such as nickel-gold, nickel-silver, nickel-palladium, and nickel-palladium-gold. Moreover, although the above-mentioned metal layer can be formed using approaches, such as plating, vacuum evaporationo, and electrodeposition, in these, the point of excelling in the homogeneity of an enveloping layer to its plating is desirable. In addition, in case this metal layer forms a solder bump etc. at a back process, it will play a role of a solder pad.
[0099] Furthermore, after filling up the above-mentioned opening for solder bump formation with soldering paste through the mask with which opening was formed in the part equivalent to the above-mentioned opening for solder bump formation if needed, the solder bump for flip chips and the solder bump for BGA (Ball Grid Array) are formed by carrying out a reflow. The substrate for IC chip mounting can be manufactured by passing through such a series of processes.
[0100] IC chip will usually be mounted in the substrate for IC chip mounting manufactured by the manufacture approach of this invention after manufacture. When for example, the above-mentioned solder bump for flip chips is formed, mounting of the above-mentioned IC chip performs flip chip mounting of IC chip through this solder bump, and is performed after that if needed by closing between IC chip and the substrates for IC chip mounting by resin. Moreover, wirebonding may perform mounting of the above-mentioned IC chip. Of course, it is not necessary to form the solder bump for a PURIPPU chip in this case.
[0101] In addition, although the solder bump for flip chips for mounting IC chip and the solder bump for BGA for connecting the substrate for IC chip mounting to other substrates (mother board etc.) are formed at the same process in the manufacture approach of the substrate for IC chip mounting of this invention mentioned above After not forming two kinds of this solder bump at the same process, for example, forming only the solder bump for a PURIPPU chip first and mounting IC chip through this solder bump, the solder bump for BGA may be

formed using soldering paste or a solder ball.
[0102]
[Example] Hereafter, this invention is further explained to a detail.
(Example 1)
A. One side copper clad laminate which 18-micrometer copper foil 8 laminates on one side of the insulating substrate 1 which consists of the glass epoxy resin with a production (1) thickness of 0.8mm or BT (bismaleimide triazine) resin of the substrate for optical element insertion was used as the start ingredient (refer to drawing 1 (a)). first, the thing for which the copper foil 8 of this one side copper clad laminate is etched in the shape of a pattern — one side of a substrate — a conductor — the circuit 4 was formed (refer to drawing 1 (b)).
[0103] (2) next, the conductor of a substrate — the side in which the circuit 4 was formed — a conductor — the adhesives layer (not shown) was formed by applying epoxy resin adhesive to the circuit agenesis section.
(3) Further, the through tube 9 was formed in the center section of a substrate by router processing, and it considered as the substrate for optical element insertion (refer to drawing 1 (c)).
[0104] B. The production bisphenol A mold epoxy resin (weight-per-epoxy-equivalent 469, Epicoat 1001 by oil-ized shell epoxy company) 30 weight section of the resin film for the resin insulating layers between the (production a) layers, [of a package substrate] The cresol novolak mold epoxy resin (weight-per-epoxy-equivalent 215, Epiclon N-673 by Dainippon Ink & Chemicals, Inc.) 40 weight section, The triazine structure content phenol novolak resin (phenol nature hydroxyl equivalent 120, Dainippon Ink & Chemicals, Inc. make FENO light KA-7052) 30 weight section The ethyl diethylene glycol acetate 20 weight section, The heating dissolution is carried out stirring in the solvent naphtha 20 weight section. There The end epoxidation polybutadiene rubber (Nagase Brothers formation DENAREKKUSU R-45 by industrial company EPT) 15 weight section, and the 2-phenyl -4, the 5-screw (hydroxymethyl) imidazole grinding article 1.5 weight section, The pulverizing silica 2 weight section and the silicon system defoaming agent 0.5 weight section were added, and the epoxy resin constituent was prepared. After applying using a roll coater so that the thickness after drying the obtained epoxy resin constituent on a PET film with a thickness of 38 micrometers may be set to 50 micrometers, the resin film for the resin insulating layers between layers was produced by making it dry for 10 minutes at 80-120 degrees C.

[0105] The mean particle diameter by which coating of the silane coupling agent was carried out to the preparation bisphenol female mold epoxy monomer (oil-ized shell company make, molecular weight : 310 YL983U) 100 weight section of the resin constituent for through tube restoration and a front face (b) By 1.6 micrometers the diameter of grain of maximum size — SiO2 spherical particle (the Adtec Corp. make —) 15 micrometers or less CRS The viscosity prepared the resin filler of 30 - 60 Pa-s at 23**1 degree C by carrying out stirring mixing of the 1101-CE72 weight section and the leveling agent (Sannopuko PERENORU S4) 1.5 weight section for a container. In addition, the imidazole curing agent (Shikoku formation shrine make, 2E4 MZ-CN) 6.5 weight section was used as a curing agent.
[0106] (c) Double-sided copper clad laminate which 18-micrometer copper foil 28 laminates to both sides of the insulating substrate 21 which consists of the glass epoxy resin with a manufacture (1) thickness of 0.8mm or BT (bismaleimide triazine) resin of a package substrate was used as the start ingredient (refer to drawing 2 (a)). first, the thing which drill drilling of this copper clad laminate is carried out, and nonelectrolytic plating processing is performed, and is etched in the shape of a pattern — both sides of a substrate — a lower layer — a conductor — the circuit 24 and the through hole 29 were formed (refer to drawing 2 (b)).
[0107] (2) a lower layer — a conductor — washing in cold water the substrate 30 in which the circuit 24 was formed, and, after drying Melanism processing the water solution containing NaOH (10g/(l.)), NaClO2 (40 g/l), and Na3PO4 (6 g/l) — melanism — it considers as a bath (oxidation bath) — and the reduction processing which makes a reduction bath NaOH (10 g/l) and the water solution containing NaBH4 (6 g/l) — carrying out — a lower layer — a conductor — the roughening side (not shown) was formed in the front face of a circuit 24.
[0108] (3) next, the following approach after preparing the resin filler indicated above (b) — after preparation — less than 24 hours — the conductor of one side of the inside of a through hole 29, and a substrate 21 — the circuit agenesis section and a lower layer — a conductor — the layer of resin filler 30' was formed in the rim section of a circuit 24. That is, after pushing in a resin filler in a through hole using a squeegee, it was made to dry on 100 degrees C and the conditions for 20 minutes first. next, a conductor — the conductor with which the part equivalent to the circuit agenesis section lays on a substrate the mask which carried out opening, and serves as a crevice using the squeegee — the circuit agenesis section was also filled up with the resin filler, and the layer of resin filler 30' was formed by making it dry on 100 degrees C and the conditions for 20 minutes (refer to drawing 2 R> 2 (c)).
[0109] (4) the belt sander [one side / which finished processing of the above (3) / of a substrate] polish using

the belt abrasive paper (Sankyo Rikagaku make) of **600 — a conductor — it ground so that resin filler 30' might remain neither in the front face of a circuit 24, nor the land front face of a through hole 29, and subsequently buffing for removing the blemish by the above-mentioned belt sander polish was performed. Such a series of polishes were similarly performed about the field of another side of a substrate. Subsequently, by 100 degrees C, it performed at 150 degrees C for 1 hour for 3 hours, 120 degrees C performed heat-treatment of 7 hours at 180 degrees C for 1 hour, and the resin filler layer 30 was formed.

[0110] Flattening of the front face of a circuit 24 is carried out. thus, a through hole 29 and a conductor — the surface section of the resin filler layer 30 formed in the circuit agenesis section, and a conductor — the resin filler layer 30 and a conductor — the insulating substrate which the side face of a circuit 24 stuck firmly through the roughening side (not shown), and the internal surface and the resin filler layer 30 of a through hole 29 stuck firmly through the roughening side (not shown) was obtained (refer to drawing 2 (d)). this process — the front face of the resin filler layer 30, and a conductor — the front face of a circuit 24 turns into the same flat surface.

[0111] (5) software etching after rinsing and carrying out acid cleaning of the above-mentioned substrate — carrying out — subsequently — an etching reagent — both sides of a substrate — a spray — spraying — a conductor — etching the front face of a circuit 24, and the land front face of a through hole 29 — a conductor — the roughening side (not shown) was formed in all the front faces of a circuit 24. As an etching reagent, the etching reagent (the product made from MEKKU, MEKKU dirty bond) containing the imidazole copper (II) complex 10 weight section, the glycolic-acid 7 weight section, and the potassium chloride 5 weight section was used.

[0112] (6) Next, by 0.5MPa, it laminated vaccum pressure arrival, the resin film for the resin insulating layers between layers produced above (a) was stuck, carrying out a temperature up to the temperature of 50-150 degrees C, and resin film layer 22alpha was formed (refer to drawing 2 (e)).

[0113] (7) Next, mind the mask with which the through tube with a thickness of 1.2mm was formed on resin film layer 22alpha. In CO2 gas laser with a wavelength of 10.4 micrometers, the beam diameter of 4.0mm, the Top Hat mode, On 8.0 microseconds of pulse width, the path of 1.0mm of the through tube of a mask, and the conditions of one shot, the opening 26 for the Bahia halls with a diameter of 80 micrometers was formed in resin film layer 22alpha, and it considered as the resin insulating layer 22 between layers (refer to drawing 3 R> 3 (a)).

[0114] (8) The roughening side (not shown) was formed in the front face of the resin insulating layer 22 between layers containing the internal surface of the opening 26 for the Bahia halls by immersing the substrate in which the opening 26 for the Bahia halls was formed, for 10 minutes in the 80-degree C solution containing 60g [/l.] permanganic acid, and carrying out dissolution removal of the epoxy resin particle which exists in the front face of the resin insulating layer 22 between layers.

[0115] (9) Next, the substrate which finished the above-mentioned processing was washed in cold water after being immersed in the neutralization solution (product made from SHIPUREI). Furthermore, the catalyst nucleus was made for the front face of this substrate that carried out the surface roughening process (a roughening depth of 3 micrometers) to adhere to the front face (for the internal surface of the opening 26 for the Bahia halls to be included) of the resin insulating layer 22 between layers by giving a palladium catalyst (not shown). That is, the above-mentioned substrate was immersed into the catalytic liquid containing a palladium chloride (PdCl2) and a stannous chloride (SnCl2), and the catalyst was given by depositing a palladium metal.

[0116] (10) Next, into the non-electrolytic copper plating liquid of the following presentations, the substrate was immersed and the non-electrolytic copper plating film (thin film conductor layer) 32 with a thickness of 0.6-3.0 micrometers was formed on the front face (the internal surface of the opening 26 for the Bahia halls is included) of the resin insulating layer 22 between layers (refer to drawing 3 (b)).

[Nonelectrolytic plating liquid]

NiSO4 0.003 mol/l tartaric acid 0.200 mol/l copper sulfate 0.030 mol/lHCHO 0.050 mol/lNaOH 0.100 mol/lalpha and alpha'-bipyridyl 100 mg/l polyethylene glycol (PEG) 0.10 g/l [nonelectrolytic plating conditions]

It is 40 minutes [0117] by whenever [34-degree C solution temperature]. (11) Next, plating resist 23 was formed by sticking a commercial photosensitive dry film on the substrate with which the non-electrolytic copper plating film 32 was formed, laying a mask, exposing by 100 mJ/cm2, and carrying out a development in a sodium-carbonate water solution 0.8% (refer to drawing 3 (c)).

[0118] (12) Subsequently, 50-degree C water washed the substrate and it degreased, with 25-degree C water, after washing with the sulfuric acid further after rinsing, electrolysis plating was performed on condition that the following, and the electrolytic copper plating film 33 was formed in the plating-resist 23 agenesis section (refer to drawing 3 R> 3 (d)).

[Electrolysis plating liquid]

Sulfuric acid 2.24 mol/l copper sulfate 0.26 mol/l additive 19.5 ml/l (made in ATOTEKKU Japan, KAPARASHIDO GL)

[Electrolysis plating conditions]
Current density 1 A/dm 2 hours 65 Part temperature 22**2 ** [0119] (13) — the nonelectrolytic plating film under the plating resist 23 after carrying out exfoliation removal of the plating resist 23 by KOH 5% further — the mixed liquor of a sulfuric acid and a hydrogen peroxide — etching processing — carrying out — dissolution removal — carrying out — the upper layer — a conductor — it considered as the circuit 25 (the Bahia hall 27 is included) (refer to drawing 4 (a)).
[0120] (14) next, the upper layer — a conductor — the substrate in which the circuit 25 grade was formed — an etching reagent — being immersed — the upper layer — a conductor — the roughening side (not shown) was formed in the front face of a circuit 25 (the Bahia hall 27 is included). In addition, as an etching reagent, the product made from MEKKU and MEKKU dirty bond were used.
[0121] (15) Next, made it dissolve so that it may become 60% of the weight of concentration to diethylene-glycol wood ether (DMDG). The oligomer (molecular weight: 4000) 46.67 weight section of the photosensitive grant which acrylic-ized 50% of epoxy groups of a cresol novolak mold epoxy resin (Nippon Kayaku Co., Ltd. make), 80% of the weight of the bisphenol A mold epoxy resin (oil-ized shell company make —) dissolved in the methyl ethyl ketone trade name: — the Epicoat 1001 15.0 weight section and an imidazole curing agent (Shikoku — formation — shrine make —) trade name: — 2 organic-functions acrylic monomer (the Nippon Kayaku Co., Ltd. make —) which are the 2E4 MZ-CN1.6 weight section and a photosensitive monomer trade name: — the R604 4.5 weight section — the same — a multiple-valued acrylic monomer (the Kyoei Kagaku K.K. make —) trade name: — the DPE6A1.5 weight section and a dispersed system defoaming agent (the Sannopuko make —) Stir the S-65 0.71 weight section for a container, mix, and a mixed constituent is prepared. The solder resist constituent which adjusted viscosity to 2.0 Pa-s at 25 degrees C was obtained by adding the benzophenone (Kanto chemistry company make) 2.0 weight section and the Michler's-ketone (Kanto chemistry company make) 0.2 weight section as a photosensitizer as a photopolymerization initiator to this mixed constituent. Moreover, in the case of 60rpm (min-1), in the case of rotor No.4 and 6rpm (min-1), measurement of viscosity was based on rotor No.3 by the Brookfield viscometer (the Tokyo Keiki Co., Ltd. make, DVL-B mold). In addition, a commercial solder resist constituent can also be used as a solder resist constituent.
[0122] (16) Next, the above-mentioned solder resist constituent was applied, for 20 minutes was performed at 70 degrees C, desiccation processing was performed to both sides of a multilayer-interconnection substrate the condition for 30 minutes at 70 degrees C, and layer 34alpha of a solder REJISU constituent was formed in them (refer to drawing 4 (b)). Subsequently, the photo mask with a thickness of 5mm with which the pattern of opening was drawn was stuck to layer 34alpha of a solder resist constituent, it exposed by the ultraviolet rays of 1000 mJ/cm2, the development was carried out with the DMTG solution, and opening 31 was formed. And further, it carried out at 120 degrees C for 1 hour for 1 hour, heat-treated [80 degrees C / 1 hour and 100 degrees C] on the conditions of 3 hours by 150 degrees C, respectively, layer 34alpha of a solder resist constituent was stiffened, and the solder resist layer 34 which has opening 31 was formed (refer to drawing 4 (c)).
[0123] (17) Next, the substrate in which the solder resist layer 34 was formed was immersed in the non-electrolyzed nickel-plating liquid of pH=4.5 containing a nickel chloride (2.3x10-1 mol/l), sodium hypophosphite (2.8x10-1 mol/l), and a sodium citrate (1.6x10-1 mol/l) for 20 minutes, and the nickel-plating layer was formed in a part of opening 31. Furthermore, the substrate was immersed in the non-electrolyzed gilding liquid containing a gold cyanide potassium (7.6x10-3 mol/l), an ammonium chloride (1.9x10-1 mol/l), a sodium citrate (1.2x10-1 mol/l), and sodium hypophosphite (1.7x10 to 1 mol/l.) for 7.5 minutes on 80-degree C conditions, the gilding layer was formed on the nickel-plating layer, and it considered as the package substrate (refer to drawing 4 (d)). In addition, all over drawing, two-layer [of a nickel-plating layer and a gilding layer] is doubled, and it is indicated as the plating layer 36.
[0124] C. The laminating press by the production (1) mass lamination method of the substrate for IC chip mounting was performed, and the substrate which stuck the substrate for optical element insertion produced by Above A and the package substrate produced by Above B through the adhesives layer formed in the above-mentioned substrate for optical element insertion was obtained (refer to drawing 5 (a)). That is, after performing both alignment, a temperature up is carried out to 150 degrees C, and the substrate for optical element insertion and the package substrate were stuck by pressing in a pan by the pressure of 5MPa(s).
[0125] (2) Next, the photo detector 38 and the light emitting device 39 were attached in the front face of the package substrate exposed from the through tube 9 formed in the substrate for optical element insertion using the silver paste so that light sensing portion 38a and light-emitting part 39a might be up exposed, respectively. In addition, as a photo detector 38, what consists of InGaAsP was used as a light emitting device 39 using what consists of InGaAs.
[0126] (3) Next, the plating layer 36 of the front face of the package substrate exposed from the electrode and

through tube 9 of a photo detector 38 and a light emitting device 39 was connected by wirebonding (refer to drawing 5 (b)). Here, the wire made from Au was used as a wire 40.

[0127] (4) Next, it was filled up with the resin constituent containing an epoxy resin by printing in the through tube 9 formed in the substrate for optical element insertion, and this resin constituent was dried after that. Furthermore, buffing and mirror polishing were given to the exposure of a resin constituent. Then, it heat-treated and considered as the resin packed bed 41 (refer to drawing 5 (c)). In addition, the permeability of the perpendicular direction of the wavelength the light of 0.85 micrometers between the top face and inferior surface of tongue of the resin packed bed 41 is 93%.

[0128] (5) Next, the through tube 46 with a diameter of 400 micrometers which penetrates the substrate for optical element insertion and a package substrate was formed by drilling (refer to drawing 6 (a)). Furthermore, DESUMIA processing was performed to the wall surface of a through tube 46 by being immersed in the 80-degree C solution containing the permanganic acid of 60 g/l for 10 minutes.

[0129] (6) Next, the substrate which finished the above-mentioned processing was washed in cold water after being immersed in the neutralization solution (product made from SHIPUREI). Furthermore, the catalyst nucleus was made to adhere to the wall surface of a through tube 46 etc. by giving a palladium catalyst to the exposure of the substrate for optical element insertion containing the wall surface of a through tube 46, and a package substrate (not shown).

[0130] (7) Next, the substrate was immersed into the non-electrolytic copper plating water solution, and the non-electrolytic copper plating film (thin film conductor layer) 52 with a thickness of 0.6-3.0 micrometers was formed in the exposure of the substrate for optical element insertion containing the wall surface of a through tube 46, and a package substrate (refer to drawing 6 (b)). In addition, it processed on the same conditions using the same thing as the nonelectrolytic plating liquid used at the process of (10) at the time of producing a package substrate as nonelectrolytic plating liquid.

[0131] (8) Next, plating resist 43 was formed by sticking a commercial photosensitive dry film on the substrate with which the non-electrolytic copper plating film 52 was formed, laying a mask, exposing by 100 mJ/cm2, and carrying out a development in a sodium-carbonate water solution 0.8% (refer to drawing 6 (c)).

[0132] (9) Subsequently, 50-degree C water washed the substrate and it degreased, and with 25-degree C water, after rinsing, after the sulfuric acid washed further, electrolysis plating was performed, and the electrolytic copper plating film 53 was formed in the plating-resist 43 agenesis section (refer to drawing 7 (a)). In addition, it processed on the same conditions using the same thing as the electrolysis plating liquid used at the process of (12) at the time of producing a package substrate as electrolysis plating liquid.

[0133] (10) Further, after carrying out exfoliation removal of the plating resist 43 by KOH 5%, etching processing of the nonelectrolytic plating film under the plating resist 43 was carried out with the mixed liquor of a sulfuric acid and a hydrogen peroxide, and dissolution removal was carried out and it considered as the through hole 49 which penetrates the substrate for optical element insertion, and a package substrate (refer to drawing 7 (b)).

[0134] (11) Next, the substrate in which the through hole 49 was formed was immersed in the etching reagent (the product made from MEKKU, MEKKU dirty bond), and the roughening side (not shown) was formed in through hole 49 wall surface (the front face of a land part is included). Next, after preparing the resin constituent for through tube restoration indicated to (b) of production of the above-mentioned package substrate, and the same resin constituent, the layer of a resin filler was formed in the through hole 49 within 24 hours after preparation by the following approach. That is, after pushing in a resin filler in a through hole 49 using a squeegee, the layer of a resin filler was formed by making it dry on 100 degrees C and the conditions for 20 minutes.

[0135] Furthermore, by belt sander polish using the belt abrasive paper (Sankyo Rikagaku make) of **600, it ground so that a resin filler might not remain in the land front face of a through hole 49, and subsequently buffing for removing the blemish by the above-mentioned belt sander polish was performed. Furthermore, by 100 degrees C, it performed at 150 degrees C for 1 hour for 3 hours, 120 degrees C performed heat-treatment of 7 hours at 180 degrees C for 1 hour, and the exposure from the through hole formed the flat resin filler layer 50 (refer to drawing 7 (c)).

[0136] (12) Next, the solder resist constituent prepared at the process of (15) of production of the above-mentioned package substrate and the same resin constituent were prepared, this was applied to both sides of a substrate, for 20 minutes was performed at 70 degrees C, desiccation processing was performed the condition for 30 minutes at 70 degrees C, and layer 54alpha of a solder REJISU constituent was formed (refer to drawing 8 (a)). In addition, a solder resist constituent was not applied to the front face of the resin packed bed 41 here. Subsequently, the photo mask with a thickness of 5mm with which the pattern of opening was drawn was stuck to layer 54alpha of a solder resist constituent, it exposed by the ultraviolet rays of 1000 mJ/cm2, the development was carried out with the DMTG solution, and opening 51 was formed. And further, it carried out at 120 degrees C for 1 hour for 1 hour, heat-treated [80 degrees C / 1 hour and 100 degrees C] on the

conditions of 3 hours by 150 degrees C, respectively, layer 54alpha of a solder resist constituent was stiffened, and the solder resist layer 54 which has opening 51 was formed (refer to drawing 8 (b)).

[0137] (13) Next, the substrate in which the solder resist layer 54 was formed was immersed in the non-electrolyzed nickel-plating liquid of pH=4.5 containing a nickel chloride (2.3x10-1 mol/l), sodium hypophosphite (2.8x10-1 mol/l), and a sodium citrate (1.6x10 to 1 mol/l.) for 20 minutes, and the nickel-plating layer 55 with a thickness of 5 micrometers was formed in a part of opening 51. Furthermore, the substrate was immersed in the non-electrolyzed gilding liquid containing a gold cyanide potassium (7.6x10-3 mol/l), an ammonium chloride (1.9x10 to 1 mol/l.), a sodium citrate (1.2x10-1 mol/l), and sodium hypophosphite (1.7x10-1 mol/l) for 7.5 minutes on 80-degree C conditions, and the gilding layer 56 with a thickness of 0.03 micrometers was formed on the nickel-plating layer 55.

[0138] (14) Next, soldering paste (Sn/Ag=96.5/3.5) was printed to the opening 51 formed in the solder resist layer 54, by carrying out a reflow at 250 degrees C, the solder bump 57 for flip chips and the solder bump 58 for BGA were formed, and the substrate for IC chip mounting was obtained (refer to drawing 8 R> 8 (c)).

[0139] (Example 2)

A. The substrate for optical element insertion and the package substrate were produced like the production example 1 of the substrate for optical element insertion, and a package substrate.

[0140] B. The laminating press by the production (1) mass lamination method of the substrate for IC chip mounting was performed, and the substrate which stuck the substrate for optical element insertion produced by Above A and the package substrate through the adhesives layer formed in the above-mentioned substrate for optical element insertion was obtained. That is, after performing both alignment, a temperature up is carried out to 150 degrees C, and the substrate for optical element insertion and the package substrate were stuck by pressing in a pan by the pressure of 5MPa(s).

[0141] (2) Next, DESUMIA processing was performed to the wall surface of a through tube by forming a through tube with a diameter of 400 micrometers which penetrates the substrate for optical element insertion, and a package substrate by drilling, and being further immersed in the 80-degree C solution containing the permanganic acid of 60 g/l for 10 minutes.

[0142] (3) Next, the substrate which finished the above-mentioned processing was washed in cold water after being immersed in the neutralization solution (product made from SHIPUREI). Furthermore, the catalyst nucleus was made to adhere to the wall surface of a through tube etc. by giving a palladium catalyst to the exposure of the substrate for optical element insertion containing the wall surface of a through tube, and a package substrate.

[0143] (4) Next, the substrate was immersed into the non-electrolytic copper plating water solution, and the non-electrolytic copper plating film (thin film conductor layer) with a thickness of 0.6-3.0 micrometers was formed in the exposure of the substrate for optical element insertion containing the wall surface of a through tube, and a package substrate. In addition, it processed on the same conditions using the same thing as the nonelectrolytic plating liquid used at the process of (10) of production of the package substrate of an example 1 as nonelectrolytic plating liquid. Moreover, at this process, the mask layer was beforehand formed in the front face of the package substrate exposed from the through tube formed in the center section of the substrate for optical element insertion by router processing so that the nonelectrolytic plating film might not be formed.

[0144] (5) Next, plating resist was prepared by sticking a commercial photosensitive dry film on the substrate with which the non-electrolytic copper plating film was formed, laying a mask, exposing by 100 mJ/cm2, and carrying out a development in a sodium-carbonate water solution 0.8%.

[0145] (6) Subsequently, 50-degree C water washed the substrate and it degreased, and with 25-degree C water, after rinsing, after the sulfuric acid washed further, electrolysis plating was performed, and the electrolytic copper plating film was formed in the plating-resist agenesis section. In addition, it processed on the same conditions using the same thing as the electrolysis plating liquid used at the process of (12) of production of the package substrate of an example 1 as electrolysis plating liquid.

[0146] (7) Further, after carrying out exfoliation removal of the plating resist by KOH 5%, etching processing of the nonelectrolytic plating film under the plating resist was carried out with the mixed liquor of a sulfuric acid and a hydrogen peroxide, and dissolution removal was carried out and it considered as the through hole which penetrates the substrate for optical element insertion, and a package substrate. Moreover, the mask layer formed at the process of the above (4) was also removed here.

[0147] (8) Next, the substrate in which the through hole was formed was immersed in the etching reagent (MEKKU dirty bond), and the roughening side was formed in the through hole wall surface (the front face of a land part is included). Next, after preparing the resin constituent for through tube restoration indicated to (b) of production of the above-mentioned package substrate of an example 1, and the same resin constituent, the layer of a resin filler was formed in the through hole within 24 hours after preparation by the following approach.

That is, after pushing in a resin filler in a through hole using a squeegee, the layer of a resin filler was formed by making it dry on 100 degrees C and the conditions for 20 minutes.
[0148] Furthermore, by belt sander polish using the belt abrasive paper (Sankyo Rikagaku make) of **600, it ground so that a resin filler might not remain in the land front face of a through hole, and subsequently buffing for removing the blemish by the above-mentioned belt sander polish was performed. Furthermore, by 100 degrees C, it performed at 150 degrees C for 1 hour for 3 hours, 120 degrees C performed heat-treatment of 7 hours at 180 degrees C for 1 hour, and the exposure from the through hole formed the flat resin filler layer.
[0149] (9) Next, the photo detector and the light emitting device were attached in the front face of the package substrate exposed from the through tube formed in the center section of the substrate for optical element insertion using the silver paste so that each light sensing portion and light-emitting part might be up exposed. In addition, as a photo detector, what consists of InGaAsP was used as a light emitting device using what consists of InGaAs.
[0150] (10) Next, the plating layer of the front face of the package substrate exposed from the electrode and through tube of a photo detector and a light emitting device was connected by wirebonding. Here, the wire made from Au was used as a wire.
[0151] (11) Next, it was filled up with the resin constituent containing an epoxy resin by printing in the through tube formed in the substrate for optical element insertion, and this resin constituent was dried after that. Furthermore, buffing and mirror polishing were given to the exposure of a resin constituent. Then, it heat-treated and considered as the resin packed bed. In addition, the permeability of the perpendicular direction of the wavelength the light of 0.85 micrometers between the top face and inferior surface of tongue of a resin packed bed is 93%.
[0152] (12) Next, the solder resist layer and the solder bump (the solder bump for flip chips and solder bump for BGA) were formed like the process of (12) - (14) of production of the substrate for IC chip mounting of an example 1, and the substrate for IC chip mounting was completed.
[0153] thus, about each of the obtained substrate for IC chip mounting of examples 1 and 2 Mount IC chip by flip chip mounting, and the end face of an optical fiber is arranged in the location which counters the light sensing portion of a photo detector. After attaching the detector in the location which counters the light-emitting part of a light emitting device and making a lightwave signal calculate with delivery and IC chip through an optical fiber after that, when the detector detected the lightwave signal, both the substrates for IC chip mounting of examples 1 and 2 were able to detect the desired lightwave signal.
[0154]
[Effect of the Invention] As explained above, while attaining the optical communication which is excellent in connection dependability by the manufacture approach of the substrate for IC chip mounting of this invention, the substrate for IC chip mounting which can be contributed to the miniaturization of a terminal equipment can be manufactured suitably.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] (a) – (c) is the fragmentary sectional view showing typically the process which produces the substrate for optical element insertion in the manufacture approach of the substrate for IC chip mounting of this invention.
[Drawing 2] (a) – (e) is the fragmentary sectional view showing typically a part of process which produces the package substrate in the manufacture approach of the substrate for IC chip mounting of this invention.
[Drawing 3] (a) – (d) is the fragmentary sectional view showing typically a part of process which produces the package substrate in the manufacture approach of the substrate for IC chip mounting of this invention.
[Drawing 4] (a) – (d) is the fragmentary sectional view showing typically a part of process which produces the package substrate in the manufacture approach of the substrate for IC chip mounting of this invention.
[Drawing 5] (a) – (c) is the fragmentary sectional view showing typically a part of manufacture approach of the substrate for IC chip mounting of this invention.
[Drawing 6] (a) – (c) is the fragmentary sectional view showing typically a part of manufacture approach of the substrate for IC chip mounting of this invention.
[Drawing 7] (a) – (c) is the fragmentary sectional view showing typically a part of manufacture approach of the substrate for IC chip mounting of this invention.
[Drawing 8] (a) – (c) is the fragmentary sectional view showing typically a part of manufacture approach of the substrate for IC chip mounting of this invention.
[Description of Notations]
1 21 Insulating substrate
8 28 Copper foil
4 and 24 a lower layer — a conductor — circuit
9 Through Tube
22 Resin Insulating Layer between Layers
23 43 Plating resist
25 Conductor — Circuit
27 Bahia Hall
29 49 Through hole
32 52 Thin film conductor layer
33 53 Electrolysis plating film
34 54 Solder resist layer
36 Plating Layer
38 Photo Detector
39 Light Emitting Device
40 Wire
41 Resin Packed Bed
57 Solder Bump for Flip Chips
58 Solder Bump for BGA

[Translation done.]